CORRELATION ANALYSIS OF AVIATION ACTIVITY VARIABLES IN RELATIONSHIP TO OPERATIONAL READINESS

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THESIS

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ACTIVITY VARIABLES IN RELATIONSHIP
TO OPERATIONAL READINESS

by

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To increase the applicability and usefullness of information available from the MIC, a correlation analysis was performed on MIC data revealing strongly associative relationships between OPERATIONAL READINESS and the following three variable ratios:

$$\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}, \frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}, \text{ and } \frac{\text{FLIGHT HOURS}}{\text{HOURS IN RRS}}.$$

Correlation Analysis of Aviation Activity Variables in Relationship to Operational Readiness

by

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Tightening fiscal monetary policies within the United States Navy has prompted Commanders at all levels of the Naval Establishment to intensify their efforts toward achieving the highest possible efficiency in utilization of the assets under their control. Commander, FIGHTER WING ONE, located at the Oceana Naval Air Station, Virginia Beach, Virginia, established a Management Information Center (MIC) to assist fighter squadron managers in this endeavor by gathering and processing data from aviation activities.

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TABLE OF SYMBOLS, ACRONYMS AND ABBREVIATIONS

Δ	-	symbol representing "is strongly correlated with"
$\not\Delta$	-	symbol representing "not Δ"
3-M	-	Monthly Maintenance and Aircraft Readiness
A799	-	code signifying unproductive maintenance action of removing a suspected subcomponent which had no defect
A799ORG	-	actions determined to be A799 within the organization
A799INT	-	actions determined to be A799 when the part involved was checked by the Intermediate Maintenance Department NOTE: TOTAL A799's = A799ORG+A799INT
ASD	-	Aircraft Statistical Data reporting
CANN	-	cannibalization, the removal of good parts from one aircraft to facilitate repair of another aircraft
EAM	-	electronic accounting machines
FSC	-	full systems capability rating for aircraft involved
MIC	-	Management Information Center
NAMP	-	Naval Aviation Maintenance Program
NFO	-	Naval Flight Officer
NOR	-	aircraft classification of Not Operationally Ready
RMC	-	aircraft classification of Reduced Material Condition

RRS - aircraft classification of in Ready Reporting Status

OPRDY - $\frac{\text{OPREADY HOURS}}{\text{HOURS IN RRS}}$, interpreted as the percentage of time during the month that those aircraft in a Readiness Reporting Status could become operationally airborne

I. INTRODUCTION

Due to increasing complexity of aircraft systems coupled with more and more constraining austerity in funding, the Navy fighter community on the east coast has recognized the necessity of developing a reliable system capable of documenting future requirements as well as assisting in the more efficient and effective utilization of resources. On 21 December 1972 Commander Fighter Wing One Instruction 5200.1 was promulgated, establishing the FITWING ONE Management Information Center (MIC). The stated purpose of the MIC was to better manage personnel and aircraft assets, enhance squadron readiness posture and ensure the highest level of professional pilot/NFO/FRAMP training.

This instruction was superceded by COMFITWING ONE INST 5200.1A dated 8 April 1974 with the purpose of continuing the development of the MIC and redefining the guidelines for reporting information to be used by the Center, including submission of 3-M (Monthly Maintenance and Aircraft Readiness) data in support of the Naval Aviation Maintenance Program (NAMP).

The MIC was designed to moniter a squadron's progress and its use of assets through the training cycle in order to identify and to forecast problems so that timely corrective action could be initiated. Squadron managers could, by examining MIC data for their squadron and comparing it to other units, determine where special attention should be

directed so as to gain maximum utilization of their assets. NAMP data was utilized to highlight problems within the community in the maintenance and supply areas so corrective action could be taken outside the community.

II. NATURE OF THE PROBLEM

The ultimate aim of the MIC was to provide timely and accurate information to squadron managers to assist them in improving their unit's overall operational readiness. To date however the system only provided a gathering of data from comparable user elements for relative ranking possibilities with no overt attempt to place judgments on respective levels of performance for different units. A graphical depiction of each user's development through his training cycle was also available for viewing in a centrally located "War Room" type display in the MIC center. The walls of the MIC room are adorned with numerous graphs indicating monthly progress of each squadron over a wide range of operational factors. Squadron managers are invited and encouraged to visit the center to view these charts firsthand to observe the comparative performance of their unit.

Data submitted periodically to the MIC was compiled for all of the individual squadrons. However, without the use of a computer and with no published analytical algorithms for statistical investigation of the data, the results of this compilation was simply a qualitative comparison of squadrons with no reference standards from which to detect individual unit deficiency or efficiency. The only published output that circulated to users was in the form of these comparability statistics, added as an item of interest to the fighter community as a whole in the Fighter Country

News, a monthly newsletter published by Fighter Wing One. Again, there was no quantification of individual unit's deviations from any established reference level of performance. In actuality, there were no statistically identified variables that might be analyzed to determine criticality levels from which to measure any given squadron's deviation.

Within this framework, the most obvious problem, existing as a necessary obstacle to overcome in order to provide more meaningful information required by unit managers, was identification of the relevancy of various reported maintenance factors in their influence upon operational readiness. Identifying those factors which, acting alone or in concert with others, prove to be major contributors to degradation or improvement in operational readiness was the desired outcome of this research effort.

III. BACKGROUND

In order to understand the workings of the MIC, it is most important to have an understanding of that portion of the Monthly Maintenance and Aircraft Readiness reporting system set up by the Department of Defense which also provides MIC inputs. Most of the data that comprises the MIC data base comes from the NAMP portion of the 3-M reporting system.

A. NAVAL AVIATION MAINTENANCE PROGRAM

The aviation (NAMP) portion of the 3-M system was designed to serve as a management information system to help achieve and maintain high material readiness through effective management of all activities involved in aviation maintenance. To do so, the program was founded on the three-level maintenance concept as established by the Department of Defense.

1. Organizational Maintenance

Organizational Maintenance includes those functions that are normally performed by an operating unit (squadron) on a day-to-day basis in support of its own operations.

2. Intermediate Maintenance

This is maintenance performed by designated activities in support of operating organizations, to include off-equipment repair or replacement.

3. Depot Maintenance

Depot Maintenance supports lower categories by performing major overhaul, rebuilding or manufacturing functions.

This NAMP system exists today with both manual data collection and entry at the lowest (organizational) level and an automatic Maintenance Data Collection System (MDCS) at Mechanicsburg, Pennsylvania for total system use.

4. NAMP Inputs

Organizational Maintenance Departments are of the "Standard Organization" type found throughout the Naval Establishment. For this reason, the NAMP was designed with a standard set of procedures, forms, transaction codes, control documents, etc., for more simplicity of reporting and to ensure more homogeneous inputs to the total system data base at MDCS, Mechanicsburg. Within the NAMP the categories of inputs recorded and reported are:

a. Man-Hour Accounting (MHA)

MHA provides data on the total utilization of maintenance personnel using the exemption principle, i.e., whenever a man is assigned duties other than maintenance, he records the time spent in such work on prepunched or handscribed EAM cards which are collected daily for machine processing. If all personnel were employed 100% in their primary maintenance functions, no man-hour cards would be submitted. Currently, MHA is used only at the direction of the Type Commander to update the existing total system data base.

b. Maintenance Data Reporting (MDR)

This is the heart of the NAMP information system. Each worker converts a narrative description of his task into codes and enters the information on standard source documents, depending on the type of work to be performed. These documents include the Support Action Form (SAF), Maintenance Action Form (MAF), and the Technical Directive Compliance Form (TDCF).

The information entered on these MDR source documents includes man-hours expended, elapsed maintenance time, identification of the branch performing the work and the item worked on, the malfunction and the corrective action taken. These documents are collected daily and sent to the station data services activity where the data are processed on EAM equipment to produce reports for both local and total NAMP system use.

c. Material Reporting (MR)

This procedure ensures that all maintenance action documents that reflect action for the local supply center are keypunched in designated columns on EAM cards and eventually sent by mail to the central data base at the Maintenance Supply Office (MSO), in Mechanicsburg, Pennsylvania.

d. Aircraft Statistical Data Reporting (ASD)

Aircraft statistical data are gathered for the reporting of operational readiness, flight and inventory status in order to isolate problem areas and estimate the impact of these areas on mission capability. Source documents for ASD include:

(1) Equipment Statistical Data (ESD) Cards. These cards are specially prepared to update an EAM Card.

(2) Flight Data (FD) Form. This is an OPNAV form utilized to show codes for various aircraft functions and activities, i.e., number of flights, total flight time, landings, the number of catapult launches, etc.

e. MDR Subsystem Output Reports

The standard outputs from the MDR subsystem of NAMP are listed below with accompanying descriptions for those reports which are utilized within the MIC.

(1) Daily Production Report (MDR-1).

(2) Monthly Production Report (MDR-2).

(3) Job Control Number Consolidation Report (MDR-3).

(4) Technical Directive Compliance Report (MDR-4). This report in two parts provides a detailed listing of TDC activity for the reporting period. It was designed to assist the squadron in scheduling and maintaining control of technical directives. Although the information contained Part 1 is identical with that in Part 2, it is sorted on different keys to provide a wider range of use.

(5) System And Component Maintenance Report (MDR-5).

(6) When Malfunction Was Discovered Report (MDR-6).

(7) Maintenance Actions By Individual Item Report (MDR-7).

(8) <u>Failed Parts Report (MDR-9)</u>.

(9) <u>Configuration By Individual Item Report (MDR-S-1)</u>.

(10) <u>No Defect Report (MDR-S-2)</u>. This report shows the amount of time that was expended on maintenance in which there was no discernible malfunction, e.g., cannibalization or removal of parts to facilitate other maintenance.

(11) <u>Foreign Object Damage Report (MDR-S-3)</u>.

(12) <u>Corrosion Control/Treatment Report (MDR-S-4)</u>. This special report is prepared on request to highlight a major problem for aircraft operating in the marine environment.

(13) <u>Maintenance Action By Bureau Number Report (MDR-S-5)</u>. This special report provides a history of maintenance actions taken on each individual aircraft, thus enabling the singling out of systems on a particular aircraft for special consideration and analysis.

(14) <u>Organization Work Center Report (MDR-S-6)</u>. This is a reformatted report of previously reported activity highlighting personnel responsible for the production within a work center.

(15) <u>Organizational Maintenance Action By Component Report (MDR-S-7)</u>. This report consolidates maintenance actions by component and serves to highlight particularly troublesome areas.

f. ASD Output Reports

The Aircraft Statistical Data Reports are prepared by the station data services facility and provide the squadron with inventory, readiness and flight data. This is a quantification of the effectiveness of individual maintenance departments. In addition to standard reports and formats, managers can request special reports as was true of the MDR subsystem. The five standard ASD reports issued to the squadrons are listed with descriptions for those that are further utilized within the MIC:

(1) <u>Aircraft Master List (ASD-00)</u>.

(2) <u>Daily Flight Report (ASD-1)</u>.

(3) <u>Daily Aircraft Readiness Report (ASD-2)</u>.

(4) <u>Monthly Aircraft Readiness and Flight Report (ASD-3)</u>. This summary report of all flight, NOR, RMC, and inventory data is used by the maintenance manager to highlight the primary cause of NOR hours as well as particular aircraft that account for a large portion of NOR/RMC hours.

(5) <u>Monthly Aircraft Awaiting Maintenance Reason Summary (ASD-4)</u>. This report was designed to aid in determining the causes of high waiting maintenance time and thereby permit efforts to be concentrated on reducible factors.

B. MANAGEMENT INFORMATION CENTER INPUT REQUIREMENTS

Inputs required by the MIC for continual update of the data base included both squadron-level reports submitted directly and 3-M printouts of the activities of each squadron. Each squadron was directed to submit weekly reports (Weekly Data Sheet), itemizing 15 factors daily over each of the seven days in the period, a Flight Activity Report detailing the type and amount of flight operations, and updates for the Aircrew Training and Readiness Report. These inputs duplicated much of the information already required of the squadrons for compliance with the 3-M documentation and readiness reporting procedures previously described. In addition, four days after the end of each period covered, the 3-M printouts for individual squadrons (MDR-4-2, MDR-S-2, MDR-S-5, MDR-S-6, MDR-S-7) were to be submitted. The monthly reports, ASD-3 and ASD-4, were required 15 days after the end of the period.

From this wealth of data the management decision process was to highlight special attention areas and forecast problems for squadron managers (users) in order to improve their ability to effectively utilize assets available and thereby improve operational readiness throughout the fighter community.

IV. DESCRIPTION OF DATA

The data utilized for this research effort was the monthly compilation of values for factors as listed in Appendix A. Data from 82 squadron-months during the 11 month period from April 1973 to March 1974 was obtained from ten non-deployed operational fleet fighter squadrons employing F-4 Phantom II aircraft. Data for the same period was obtained for the Readiness Training Squadron and its Detachment; however, this data of necessity was analysed separately due to their differing missions and flight priorities from that of operational fleet squadrons. This data was obtained from the data base maintained by the Management Information Center of Fighter Wing One located at the Naval Air Station Oceana, Virginia.

V. ANALYTICAL PROCEDURE

Although one might hope for some optimal methodology for the analysis and appraisal of a given system, it is usually the case that peculiarities in development or functional attributes preclude strict adherence to a unique analytical procedure. In this study of operational readiness, data limitations precluded a regression analysis that might have the capability of predicting exact changes in operational readiness due to a specified change in one or more independent variables. Data was not available in sufficient quantity, covering a sufficiently large time span or number of reporting squadrons to enable identification of all or most factors that influence operational readiness.

Although precluded from completing a regression analysis showing causation of changes in operational readiness, the writer was able to conclude which factors exhibited strong associativity with operational readiness, the variable of interest. Correlation Analysis provides the researcher with a single summary statistic describing the strength of association between two variables. This statistic, the correlation coefficient, indicates the degree of association in a linear relationship between variables, ranging in value from -1.0 to +1.0. "A coefficient of 0 always indicates that no linear relationship exists; a +1.0 coefficient implies a 'perfect' positive relationship (i.e., an increase in one

variable is always associated with a concommitant increase in the other variable); and a coefficient of -1.0 indicates a 'perfect' negative relationship (i.e., one in which an increase in one wariable is always associated with a decrease in the other variable)."[1]

Whenever associations exist between a dependent variable and a set of independent variables, better understanding of true association relationships can be achieved through Partial-Correlation Analysis. The partial-correlation coefficient measured on the dependent variable and one of a set of independent variables is taken by controlling for all other independent variables. Since the dependent variable and the independent variable of interest are multiply correlated with the remaining independent variables, the partial correlation is computed by "subtracting out" the multiple correlation with the remaining variables. Partial correlation provides the researcher with a single measure of association describing the relationship between two variables while adjusting for the effects of one or more additional variables called "control" variables. A clear and concise explanation of this procedure is presented in <u>SPSS Statistical Package for the Social Sciences</u>, by Nie, Bent, and Hull, authors, McGraw-Hill, 1970, and is quoted in part below:

> "The control is statistical rather than literal and is based on the simplifying assumptions of linear relationships among the variables. In essence,

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[1] Nie, Norman, Bent, D.H., and Hull, C.H., <u>SPSS Statistical Package for the Social Sciences</u>, p. 144, McGraw-Hill, 1970.

partial correlation enables the researcher to remove the effect of the control variable from the relationship between the independent and dependent variables without physically manipulating the raw data. In partial correlation the effect of the control variable(s) is assumed to be linear throughout the range of the control variable, and it is this linear assumption that makes partial correlation possible.

Once one knows the linear relationship among the independent, dependent, and control variables, the partial correlation coefficient can be calculated by constructing (statistically, that is) new independent and dependent variables with the effect of the control variable(s) removed. This is done by making a prediction (based on the simple correlation coefficients) of both the independent and dependent variables from the knowledge of the effect that the control variable has on them. The new or adjusted independent variable is constructed by taking the difference between the actual value of the original independent variable (for each observation) and its value as predicted by the control variable. This new variable is, by definition, uncorrelated with each and/or all control variables which have been entered. The same procedure is then repeated for the dependent variable. The linear effect of the control variable(s) has now been removed from both the independent and dependent variables, and the simple correlation between these adjusted variables is the partial correlation. However, since correlation coefficients are a complete description of the bivariate linear relationships among all the variables involved, this procedure can be statistically achieved from the correlation matrix alone, without reference to the individual observations. Therefore, when one computes the partial-correlation coefficient from the correlation matrix, the result is the same as if one had calculated the residuals for each observation (based on the effects of the control variable(s)) and had then computed a new simple correlation between the two sets of residuals. That is what we mean by adjusting the value based on the prediction from the simple correlation."[2]

"Partial Correlation can be used in a variety of ways to aid the researcher in understanding and clarifying relationships between three or more variables. When properly employed, partial correlation becomes an excellent technique for uncovering spurious relationships, locating intervening variables, and can even be used to help the researcher make certain types

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[2] Ibid., p. 158.

of causal inferences. ...A 'spurious correlation' is defined as a relationship between two variables (A and B for example) in which A's correlation with B is solely the result of the fact that A varies along with some other variable (C for example) which is indeed the true predictor of B. In this case, when the effects of C are controlled, held constant, etc., B no longer varies with A."[3]

"Another important feature of partial correlation lies in its ability to aid the researcher in a search for intervening linking variables. While there is no statistical difference between the computation of partials employed to locate spurious relationships and those used to determine intervening variables, the conceptual issues are different enough to merit separate treatment. The search for intervening variables is highly related to the issue of causality insofar as the researcher wishes to make statements of the sort: A leads to B which in turn leads to C. While partial correlation can be of great assistance in such problems, the researcher's theory (i.e., his ability to place a time-series ordering to his variables) becomes much more important in these types of situations."[4]

A third ... "usage of partial correlation deals again with a slightly different problem: locating relationships where none appear to exist. Here too the statistical method is identical, but the conceptual issues are a bit different. One sometimes encounters situations where theory or intuitive judgment leads one to believe that there should be a relationship between two variables, but the data simply do not indicate any relationship. When this is the case, there is the possibility that some other variable or variables are acting to hide or suppress the relationship. These suppressor relationships often take the form of 'A shows no relationship to B because A is negatively related to C which in turn is positively related to B.' Hence A is positively related to B when one controls for the effects of C."[5]

In seeking to make inferences about the influence of specific variables upon operational readiness the writer concentrated his efforts upon those variables for which data

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[3] Ibid., p. 159.

[4] Ibid., p. 160.

[5] Ibid., p. 161.

had been collected, recorded and retained, and upon which squadron managers were able to effect a certain amount of control through their management decisions. Appendix B contains several nine-by-nine partial-correlation matrices, both zero-order (simple) correlations and first-order partial-correlation matrices controlling for one of the variables of interest in each matrix. The matrices delineate the correlation coefficients measuring the strength of association between operational readiness (OPRDY) and nine other variables either taken directly from the MIC data base or resulting from algebraic manipulation of several direct input variables to the MIC. Accompanying the coefficient of correlation between two variables is the chi-squared statistical significance level of reliability for the coefficient as determined by the number of observations and the variances of the two measures correlated.

A. MATRIX ENTRY INTERPRETATION

1. Zero-Order Partials

The zero-order partials or simple correlation matrix for the ten fleet squadrons was based upon 82 observations of the variables to be associated. Since each correlation involves two of these variables, the resulting coefficients will bear a chi-squared significance figure based upon 80 degrees of freedom. The monthly data for all squadrons was pooled under the assumption of no between-squadron differences will occur as each completes an entire training cycle.

	OPRDY
$\frac{\text{FSC HOURS}^{6}}{\text{HOURS IN RRS}}$	0.5702
	S=0.001

In regard to the typical matrix entry example above, the proper interpretation would be that there is a definite positive association between OPRDY and $\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$. For 80 degrees of freedom this coefficient is significant at the .001 level, i.e., one can statistically state that the positive association exists and will only be wrong in that assertion one time in a thousand. Thus with near certainty one could predict that a rise in the ratio of FSC HOURS to HOURS IN RRS will concomitantly have an associated rise in OPRDY. Had the coefficient been negative and at such a high degree of significance, the only change in interpretation would be that a rise in one of the variables will be associated with an accompanying decrease in the other.

2. First-Order Partials

The interpretation of the matrix entries in a first-order partial-correlation matrix is the same as for the zero-order correlation interpretation. The difference that underlies the changes in the values and significance levels of the actual coefficients is that the linear effects of the variable being controlled for have been removed statistically

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[6] The definition of all variables used in the analysis is given in the Table of Symbols, Acronyms and Abbreviations.

prior to the computation of the correlation coefficient. As a result, the degrees of freedom, for the statistical significance ranking of the coefficient, have decreased by one, the number of variables being withdrawn in effect. Changes in value and significance of the coefficients from zero to first-order partial correlation have various interpretations and are discussed on a case-by-case basis.

VI. RESULTS AND INTERPRETATION

As previously stated, data limitations in quantity and scope of variable factors included in the data base precluded success in obtaining a regression analysis functional delineation of operational readiness. Although many attempts were made, the fact that a sufficient number of explanatory variables were not identified was born out by the fact that the highest proportion of the standard derivation in the dependent variable accounted for by the regression equation on any regression was 0.6, indicating a possible explanation of only one-third of the variance in OPRDY values.

Correlation between A799INT and TOTAL A799's was .5843 and that between A799ORG and TOTAL A799's was .8946, both significant at the .001 level. Therefore, of the three, TOTAL A799's alone was retained for subsequent analysis with the certain belief in the extention of any findings to encompass the remaining two in this strongly associated triad. This particular technique was utilized for reduction in the number of variables under direct analysis. Additionally, it was found that many of the variables could easily be combined into meaningful ratios whose associative relationships with OPRDY could be determined and used extensively in the analysis.

A completely comprehensive computation of possible zero and first-order partial-correlations was accomplished and edited to remove from consideration those variables with no

apparent association with OPRDY. Much of the results of this research effort can be observed through close examination of the partial-correlation matrices in Appendix B.

A. ZERO-ORDER CORRELATION RESULTS

Those variables that were determined to be most strongly associated with OPRDY as shown in the zero-order partials, Appendix B, figure 2, are listed below with their coefficients and adjudged levels of statistical significance. The writer conservatively required significance S $\leq$ 0.010 to consider the correlation "strong."

VARIABLE	COEFFICIENT	SIGNIFICANCE
$\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$	0.5702	S=0.001
$\frac{\text{FSC HOURS}}{\text{TOTAL A799's}}$	0.4428	S=0.001
$\frac{\text{FSC HOURS}}{\text{FLIGHT HOURS}}$	0.3611	S=0.001
TOTAL A799's	-0.3438	S=0.001
$\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$	0.3145	S=0.002
$\frac{\text{FLIGHT HOURS}}{\text{CANN ACTIONS}}$	0.2555	S=0.010

B. FIRST-ORDER PARTIAL-CORRELATION RESULTS

After initial identification of primary variables exhibiting strong associativity with OPRDY, determination was made as to the nature of this correlation. Utilizing the principles discussed in ANALYTICAL PROCEDURE, distinction was made between variables exhibiting spurious correlation

to OPRDY, those which were intervening linking variables, those suppressing or hiding a true predictor correlation and those variables which maintain a genuine strongly associative relationship with OPRDY. To facilitate the comprehension of results, the writer utilized "Δ" to signify "is strongly (i.e., significance ≤ 0.010) correlated with" and "$\not\Delta$" to mean "not Δ".

1. Spurious Relationships

A spurious correlation is indicated by the following series of associations: A Δ OPRDY, B Δ OPRDY, A Δ B; but when one controls for B, then A $\not\Delta$ OPRDY. This indicates A was spuriously correlated with OPRDY. The following list indicates those variables identified as spurious and which control variables were seen to reveal the spurious correlation:

SPURIOUS with OPRDY	CONTROL VARIABLE
$\frac{\text{FSC HOURS}}{\text{TOTAL A799's}}$	$\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$
$\frac{\text{FSC HOURS}}{\text{FLIGHT HOURS}}$	$\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$ or $\frac{\text{FSC HOURS}}{\text{TOTAL A799's}}$
TOTAL A799's	$\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$ or $\frac{\text{FSC HOURS}}{\text{TOTAL A799's}}$ or $\frac{\text{FSC HOURS}}{\text{FLIGHT HOURS}}$
$\frac{\text{FLIGHT HOURS}}{\text{CANN ACTIONS}}$	$\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$ or $\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$

This process left only two remaining variables as truly significantly correlated to OPRDY: $\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$ and $\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$.

2. Intervening Linking Variables

Numerous examples of the intervening linking relationships of variables are evident from a review of the correlation matrices. For example, although CANN ACTIONS $\not\Delta$ OPRDY, it does have a strong relationship with $\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$, which is in turn Δ OPRDY. Thus $\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$ acts as a "link" from CANN ACTIONS to OPRDY.

3. Suppressor Relationships

If A is negatively correlated to C while C is positively correlated with B, A may appear to lack any correlation with B. In many cases a true correlation exists but is effectively being suppressed by the presence of C. When one statistically controls for C, the algebraic cancelling effect is removed and the real relationship between A and B is revealed.

$\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$, $\frac{\text{FSC HOURS}}{\text{TOTAL A799's}}$, and $\frac{\text{FSC HOURS}}{\text{FLIGHT HOURS}}$ are all negatively correlated with $\frac{\text{FLIGHT HOURS}}{\text{HOURS IN RRS}}$ and they are all positively correlated with OPRDY. When any one of the three are controlled for, the apparent lack of correlation between $\frac{\text{FLIGHT HOURS}}{\text{HOURS IN RRS}}$ and OPRDY disappears. Controlling for any of these masking variables produced first-order partials revealing a highly significant correlation and dictating the inclusion of $\frac{\text{FLIGHT HOURS}}{\text{HOURS IN RRS}}$ along with $\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$ and $\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$ to form a triad of significantly important variables in their associative relationships to OPRDY.

C. INTERPRETATION OF RESULTS

The research yielded three ratios which were significantly correlated with OPRDY. $\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$, $\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$ and $\frac{\text{FLIGHT HOURS}}{\text{HOURS IN RRS}}$ all exhibit strong positive relationships with operational readiness; therefore, increasing the value of any of these ratios should concomitantly increase OPRDY. Proper interpretation of these results is essential in achieving that goal.

The highly significant negative correlation of both TOTAL A799's and CANN ACTIONS with $\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$ indicates that the desired increase in this ratio would be achieved if squadron managers could reduce either TOTAL A799's or CANN ACTIONS or both. Actually the strong relationship between CANN ACTIONS and TOTAL A799's indicates that one leads to the other. A possible intuitive interpretation of the causes of these correlations is that, when expediency overrides accuracy in diagnostic maintenance decisions, casual authorization of cannibalization to supply needed subcomponents could lead to the degradation of strictly disciplined proper trouble-shooting of apparent malfunctions. The easy decision to replace a suspected item with a cannibalized part may influence technicians to remove an item before insuring that it truly was defective. Thus, lenient cannibalization standards could lead to a rise in A799's due to poor trouble-shooting.

Since correlation only indicates the associativity of two variables, one must investigate the possibility that it

is an increase in A799's that prompts an increase in CANN ACTIONS. Once again an intuitive possibility is that in-experienced or unmotivated trouble-shooters permit many non-defective subcomponents to be removed and sent away for repair. Faced with a Supply Dept. response time lag squadron managers could decide to speed the return of this downed aircraft to an up status by cannibalizing a replacement part from another downed aircraft. Thus increasing A799's could lead to increasing CANN ACTIONS. Whichever causal relationship more nearly mirrors the real situation is unimportant! The object remains to reduce one or both these variables to achieve an increase in $\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$ and OPRDY.

In addition to both being strongly related to OPRDY, the ratios $\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$ and $\frac{\text{FLIGHT HOURS}}{\text{HOURS IN RRS}}$ are highly correlated to each other. Thus, circumstances causing a change in either one should likewise effect the other two. If squadron managers could increase $\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$, then operational readiness should also increase. The ratio could be increased by either reducing the TOTAL A799's without reducing FLIGHT HOURS or by increasing FLIGHT HOURS while holding TOTAL A799's to a proportionately smaller increase. As seen in the previous discussion, holding A799's down means that the increase in FLIGHT HOURS must come from other than an increase in CANN ACTIONS.

The only alternative is to change maintenance methods such that the direct correlation between CANN ACTIONS and TOTAL A799's is removed. Since this analysis was based on

past data, it merely indicates the relationships that "were" in existence, but they should persist as long as methods remain unchanged. These observations should not be taken as a direct denial of the advantages to be gained by employing cannibalization. The data supports the conclusion that cannibalization increases flight hours, i.e., CANN ACTIONS Δ $\frac{\text{FLIGHT HOURS}}{\text{HOURS IN RRS}}$. Additionally, CANN ACTIONS Δ $\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$, indicating that the use of cannibalization for expediting aircraft return to flight status will increase flight hours proportionally more than it will increase the A799's. While the research was directed toward the discovery of factors important to the increase of operational readiness, it should not be interpreted to the exclusion of a meaningful practice. When the squadron manager is confronted with the needs of training his personnel, mission accomplishment in the short run could be judged much more important than the long run effects of an individual cannibalization upon the monthly level of OPRDY.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

Operational Readiness, OPRDY, was found to be most strongly associated with three ratios: $\frac{\text{FSC HOURS}}{\text{HOURS IN RRS}}$, $\frac{\text{FLIGHT HOURS}}{\text{HOURS IN RRS}}$, and $\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$. These ratios appear most readily controlled by squadron managers through decisions effecting cannibalization actions and the number of A799's. This analysis was based upon data grouped under the assumption that all operational fleet squadrons experience the same influences as they progress in a standardized training cycle. Therefore the results should be generalizable to any non-deployed fleet fighter squadron that employs F-4 aircraft.

The insufficient data from the Readiness Training Squadron prevented its inclusion; however, the two most significant ratios found were $\frac{\text{FLIGHT HOURS}}{\text{HOURS IN RRS}}$ and $\frac{\text{FLIGHT HOURS}}{\text{TOTAL A799's}}$, the same as above. Although similarity exists, it would be improper to assume the relationships to be the same without further study.

The data utilized was "real world", representing squadrons in equilibrium steady state operating circumstances. Thus the range of the variables was restricted to valid ranges, yielding meaningful statistical relationships since the desired goal was to illustrate those relationships as they exist with OPRDY in the normal environment.

B. RECOMMENDATIONS

It is recommended that squadron managers ensure strict compliance with standard trouble-shooting procedures to reduce the occurrence of A799's. While the decision to cannibalize should rightfully remain within the squadron managers perview, it is recommended that the historically damaging effects of cannibalization be weighted heavily against the timeliness of training mission accomplishment.

It is recommended that the importance of proper data input and maintenance within the MIC be emphasized and that continued accumulation of data be directed in order that future studies may include a more definitive analysis of the Readiness Training Squadron as well as providing the base for a much more precise regression analysis in the field of aviation activities.

APPENDIX A

SAMPLE DATA INPUT SHEET

TYPE A/C _______

MONTH __________

	SQUADRON A	SQUADRON B	....	SQUADRON N
HOURS IN RRS				
ACFT IN RRS				
FLIGHT HOURS				
OPRDY HOURS				
OPRDY %				
FSC HOURS				
CANN ACTIONS				
CANN HOURS				
A799ORG				
A799INT				

Although this isn't the exact form the input data was taken from, this illustrates those variables utilized in the research effort.

APPENDIX B

PARTIAL-CORRELATION MATRICES

The significance level corresponding to the correlation coefficient entries in the matrices included result from a chi-squared test of significance with the following degrees of freedom:

Figure 2, ZERO-ORDER PARTIALS ------ 80 degrees of freedom

Figures 3-10, FIRST-ORDER PARTIALS - 79 degrees of freedom

The means and standard deviations of the three ratios determined to be most associative with operational readiness are:

RATIO	MEAN	STANDARD DEVIATION
FSC HOURS / HOURS IN RRS	0.3491	0.1781
FLIGHT HOURS / TOTAL A799's	2.2298	1.0224
FLIGHT HOURS / HOURS IN RRS	0.0315	0.0155

Figure 1

PARTIAL CORRELATION COEFFICIENTS

	OPRDY	FSC HOURS / TOT A799s	FSC HOURS / HRS IN RRS	FLT HOURS / CANN ACTS	FLT HOURS / TOT A799s	FSC HOURS / FLT HOURS	FLT HOURS / HRS IN RRS	TOT A799s	CANN ACTS
OPRDY		0.4428 (80) S=0.001	0.5702 (80) S=0.001	0.2555 (80) S=0.010	0.3145 (80) S=0.002	0.3611 (80) S=0.001	0.1311 (80) S=0.120	-0.3438 (80) S=0.001	-0.0385 (80) S=0.366
FSC HOURS / TOT A799s	0.4428 (80) S=0.001		0.5674 (80) S=0.001	0.0824 (80) S=0.231	0.0172 (80) S=0.439	0.8977 (80) S=0.001	-0.3432 (80) S=0.001	-0.4336 (80) S=0.001	-0.3007 (80) S=0.003
FSC HOURS / HRS IN RRS	0.5702 (80) S=0.001	0.5674 (80) S=0.001		0.1998 (80) S=0.036	0.0158 (80) S=0.444	0.5331 (80) S=0.001	-0.2019 (80) S=0.034	-0.3710 (80) S=0.001	-0.3462 (80) S=0.001
FLT HOURS / CANN ACTS	0.2555 (80) S=0.010	0.0824 (80) S=0.231	0.1998 (80) S=0.036		0.1650 (80) S=0.069	0.0090 (80) S=0.468	0.0880 (80) S=0.216	-0.0828 (80) S=0.230	-0.3655 (80) S=0.001
FLT HOURS / TOT A799s	0.3145 (80) S=0.002	0.0172 (80) S=0.439	0.0158 (80) S=0.444	0.1650 (80) S=0.069		-0.2158 (80) S=0.026	0.6508 (80) S=0.001	-0.2244 (80) S=0.021	0.2428 (80) S=0.014
FSC HOURS / FLT HOURS	0.3611 (80) S=0.001	0.8977 (80) S=0.001	0.5331 (80) S=0.001	0.0090 (80) S=0.468	-0.2158 (80) S=0.026		-0.4709 (80) S=0.001	-0.3918 (80) S=0.001	-0.3109 (80) S=0.002
FLT HOURS / HRS IN RRS	0.1311 (80) S=0.120	-0.3432 (80) S=0.001	-0.2019 (80) S=0.034	0.0880 (80) S=0.216	0.6508 (80) S=0.001	-0.4709 (80) S=0.001		0.3763 (80) S=0.001	0.5288 (80) S=0.001
TOT A799s	-0.3438 (80) S=0.001	-0.4336 (80) S=0.001	-0.3710 (80) S=0.001	-0.0828 (80) S=0.230	-0.2244 (80) S=0.021	-0.3918 (80) S=0.001	0.3763 (80) S=0.001		0.4453 (80) S=0.001
CANN ACTS	-0.0385 (80) S=0.366	-0.3007 (80) S=0.003	-0.3462 (80) S=0.001	-0.3655 (80) S=0.001	0.2428 (80) S=0.014	-0.3109 (80) S=0.002	0.5288 (80) S=0.001	0.4453 (80) S=0.001	

(Coefficient/(D.F.)/Significance)

Figure 2. Zero Order Partials

PARTIAL CORRELATION COEFFICIENTS

	OPRDY	FSC HOURS / TOT A799s	FSC HOURS / HRS IN RRS	FLT HOURS / CANN ACTS	FLT HOURS / TOT A799s	FSC HOURS / FLT HOURS	FLT HOURS / HRS IN RRS	TOT A799s	CANN ACTS
OPRDY			0.4321 (79) S=0.001	0.2451 (79) S=0.014	0.3424 (79) S=0.001	-0.0922 (79) S=0.207	0.3361 (79) S=0.001	-0.1879 (79) S=0.046	0.1107 (79) S=0.163
FSC HOURS / TOT A799s									
FSC HOURS / HRS IN RRS	0.4321 (79) S=0.001			0.1865 (79) S=0.048	0.0073 (79) S=0.474	0.0653 (79) S=0.281	-0.0093 (79) S=0.467	-0.1684 (79) S=0.066	-0.2236 (79) S=0.022
FLT HOURS / CANN ACTS	0.2451 (79) S=0.014		0.1865 (79) S=0.048		0.1642 (79) S=0.072	-0.1480 (79) S=0.094	0.1243 (79) S=0.135	-0.0525 (79) S=0.321	-0.3585 (79) S=0.001
FLT HOURS / TOT A799s	0.3424 (79) S=0.001		0.0073 (79) S=0.474	0.1642 (79) S=0.072		-0.5248 (79) S=0.001	0.6993 (79) S=0.001	-0.2408 (79) S=0.015	0.2600 (79) S=0.010
FSC HOURS / FLT HOURS	-0.0922 (79) S=0.207		0.0653 (79) S=0.281	-0.1480 (79) S=0.094	-0.5248 (79) S=0.001		-0.3934 (79) S=0.001	-0.0066 (79) S=0.477	-0.0974 (79) S=0.194
FLT HOURS / HRS IN RRS	0.3361 (79) S=0.001		-0.0093 (79) S=0.467	0.1243 (79) S=0.135	0.6993 (79) S=0.001	-0.3934 (79) S=0.001		0.2688 (79) S=0.008	0.4752 (79) S=0.001
TOT A799s	-0.1879 (79) S=0.046		-0.1684 (79) S=0.066	-0.0525 (79) S=0.321	-0.2408 (79) S=0.015	-0.0066 (79) S=0.477	0.2688 (79) S=0.008		0.3665 (79) S=0.001
CANN ACTS	0.1107 (79) S=0.163		-0.2236 (79) S=0.022	-0.3585 (79) S=0.001	0.2600 (79) S=0.010	-0.0974 (79) S=0.194	0.4752 (79) S=0.001	0.3665 (79) S=0.001	

(Coefficient/(D.F.)/Significance)

Figure 3. First Order Partials Controlling for $\frac{\text{FSC HOURS}}{\text{TOT A799s}}$

PARTIAL CORRELATION COEFFICIENTS

	OPRDY	FSC HOURS / TOT A799s	FSC HOURS / HRS IN RRS	FLT HOURS / CANN ACTS	FLT HOURS / TOT A799s	FSC HOURS / FLT HOURS	FLT HOURS / HRS IN RRS	TOT A799s	CANN ACTS
OPRDY		0.1762 (79) S=0.058		0.1760 (79) S=0.058	0.3720 (79) S=0.001	0.0822 (79) S=0.233	0.3061 (79) S=0.003	-0.1734 (79) S=0.061	0.2062 (79) S=0.032
FSC HOURS / TOT A799s	0.1762 (79) S=0.058			-0.0383 (79) S=0.367	0.0100 (79) S=0.465	0.8544 (79) S=0.001	-0.2835 (79) S=0.005	-0.2917 (79) S=0.004	-0.1350 (79) S=0.115
FSC HOURS / HRS IN RRS									
FLT HOURS / CANN ACTS	0.1760 (79) S=0.058	-0.0383 (79) S=0.367			0.1652 (79) S=0.070	-0.1176 (79) S=0.148	0.1338 (79) S=0.117	-0.0096 (79) S=0.466	-0.3224 (79) S=0.002
FLT HOURS / TOT A799s	0.3720 (79) S=0.001	0.0100 (79) S=0.465		0.1652 (79) S=0.070		-0.2650 (79) S=0.008	0.6679 (79) S=0.001	-0.2354 (79) S=0.017	0.2647 (79) S=0.008
FSC HOURS / FLT HOURS	0.0822 (79) S=0.233	0.8544 (79) S=0.001		-0.1176 (79) S=0.148	-0.2650 (79) S=0.008		-0.4383 (79) S=0.001	-0.2470 (79) S=0.013	-0.1592 (79) S=0.078
FLT HOURS / HRS IN RRS	0.3061 (79) S=0.003	-0.2835 (79) S=0.005		0.1338 (79) S=0.117	0.6679 (79) S=0.001	-0.4383 (79) S=0.001		0.3314 (79) S=0.001	0.4995 (79) S=0.001
TOT A799s	-0.1734 (79) S=0.061	-0.2917 (79) S=0.004		-0.0096 (79) S=0.466	-0.2354 (79) S=0.017	-0.2470 (79) S=0.013	0.3314 (79) S=0.001		0.3637 (79) S=0.001
CANN ACTS	0.2062 (79) S=0.032	-0.1350 (79) S=0.115		-0.3224 (79) S=0.002	0.2647 (79) S=0.008	-0.1592 (79) S=0.078	0.4995 (79) S=0.001	0.3637 (79) S=0.001	

(Coefficient/(D.F.)/Significance)

Figure 4. First Order Partials Controlling for $\frac{\text{FSC HOURS}}{\text{HRS IN RRS}}$

P A R T I A L   C O R R E L A T I O N   C O E F F I C I E N T S

	OPRDY	FSC HOURS / TOT A799s	FSC HOURS / HRS IN RRS	FLT HOURS / CANN ACTS	FLT HOURS / TOT A799s	FSC HOURS / FLT HOURS	FLT HOURS / HRS IN RRS	TOT A799s	CANN ACTS
OPRDY		0.4377 (79) S=0.001	0.5481 (79) S=0.001		0.2856 (79) S=0.005	0.3711 (79) S=0.001	0.1128 (79) S=0.158	-0.3349 (79) S=0.001	0.0610 (79) S=0.294
FSC HOURS / TOT A799s	0.4377 (79) S=0.001		0.5642 (79) S=0.001		0.0036 (79) S=0.487	0.9001 (79) S=0.001	-0.3530 (79) S=0.001	-0.4297 (79) S=0.001	-0.2917 (79) S=0.004
FSC HOURS / HRS IN RRS	0.5481 (79) S=0.001	0.5642 (79) S=0.001			-0.0178 (79) S=0.437	0.5422 (79) S=0.001	-0.2249 (79) S=0.022	-0.3630 (79) S=0.001	-0.2995 (79) S=0.003
FLT HOURS / CANN ACTS									
FLT HOURS / TOT A799s	0.2856 (79) S=0.005	0.0036 (79) S=0.487	-0.0178 (79) S=0.437			-0.2203 (79) S=0.024	0.6477 (79) S=0.001	-0.2144 (79) S=0.027	0.3302 (79) S=0.001
FSC HOURS / FLT HOURS	0.3711 (79) S=0.001	0.9001 (79) S=0.001	0.5422 (79) S=0.001		-0.2203 (79) S=0.024		-0.4735 (79) S=0.001	-0.3924 (79) S=0.001	-0.3305 (79) S=0.001
FLT HOURS / HRS IN RRS	0.1128 (79) S=0.158	-0.3530 (79) S=0.001	-0.2249 (79) S=0.022		0.6477 (79) S=0.001	-0.4735 (79) S=0.001		0.3864 (79) S=0.001	0.6051 (79) S=0.001
TOT A799s	-0.3349 (79) S=0.001	-0.4297 (79) S=0.001	-0.3630 (79) S=0.001		-0.2144 (79) S=0.027	-0.3924 (79) S=0.001	0.3864 (79) S=0.001		0.4474 (79) S=0.001
CANN ACTS	0.0610 (79) S=0.294	-0.2917 (79) S=0.004	-0.2995 (79) S=0.003		0.3302 (79) S=0.001	-0.3305 (79) S=0.001	0.6051 (79) S=0.001	0.4474 (79) S=0.001	

(Coefficient/(D.F.)/Significance)

Figure 5. First Order Partials Controlling for $\frac{\text{FLT HOURS}}{\text{CANN ACTS}}$

PARTIAL CORRELATION COEFFICIENTS

	OPRDY	FSC HOURS / TOT A799s	FSC HOURS / HRS IN RRS	FLT HOURS / CANN ACTS	FLT HOURS / TOT A799s	FSC HOURS / FLT HOURS	FLT HOURS / HRS IN RRS	TOT A799s	CANN ACTS
OPRDY		0.4608 (79) S=0.001	0.5956 (79) S=0.001	0.2175 (79) S=0.026		0.4628 (79) S=0.001	-0.1021 (79) S=0.182	-0.2954 (79) S=0.004	-0.1248 (79) S=0.134
FSC HOURS / TOT A799s	0.4608 (79) S=0.001		0.5673 (79) S=0.001	0.0807 (79) S=0.237		0.9233 (79) S=0.001	-0.4668 (79) S=0.001	-0.4410 (79) S=0.001	-0.3143 (79) S=0.002
FSC HOURS / HRS IN RRS	0.5956 (79) S=0.001	0.5673 (79) S=0.001		0.1999 (79) S=0.037		0.5495 (79) S=0.001	-0.2795 (79) S=0.006	-0.3771 (79) S=0.001	-0.3609 (79) S=0.001
FLT HOURS / CANN ACTS	0.2175 (79) S=0.026	0.0807 (79) S=0.237	0.1999 (79) S=0.037			0.0463 (79) S=0.341	-0.0258 (79) S=0.409	-0.0477 (79) S=0.336	-0.4239 (79) S=0.001
FLT HOURS / TOT A799s									
FSC HOURS / FLT HOURS	0.4628 (79) S=0.001	0.9233 (79) S=0.001	0.5495 (79) S=0.001	0.0463 (79) S=0.341			-0.4457 (79) S=0.001	-0.4627 (79) S=0.001	-0.2729 (79) S=0.007
FLT HOURS / HRS IN RRS	-0.1021 (79) S=0.182	-0.4668 (79) S=0.001	-0.2795 (79) S=0.006	-0.0258 (79) S=0.409		-0.4457 (79) S=0.001		0.7060 (79) S=0.001	0.5035 (79) S=0.001
TOT A799s	-0.2954 (79) S=0.004	-0.4410 (79) S=0.001	-0.3771 (79) S=0.001	-0.0477 (79) S=0.336		-0.4627 (79) S=0.001	0.7060 (79) S=0.001		0.5287 (79) S=0.001
CANN ACTS	-0.1248 (79) S=0.134	-0.3143 (79) S=0.002	-0.3609 (79) S=0.001	-0.4239 (79) S=0.001		-0.2729 (79) S=0.007	0.5035 (79) S=0.001	0.5287 (79) S=0.001	

(Coefficient/(D.F.)/Significance)

Figure 6. First Order Partials Controlling for $\frac{\text{FLT HOURS}}{\text{TOT A799s}}$

PARTIAL CORRELATION COEFFICIENTS

	OPRDY	FSC HOURS / TOT A799s	FSC HOURS / HRS IN RRS	FLT HOURS / CANN ACTS	FLT HOURS / TOT A799s	FSC HOURS / FLT HOURS	FLT HOURS / HRS IN RRS	TOT A799s	CANN ACTS
OPRDY		0.2887 (79) S=0.004	0.4788 (79) S=0.001	0.2706 (79) S=0.007	0.4310 (79) S=0.001		0.3661 (79) S=0.001	-0.2358 (79) S=0.017	0.0832 (79) S=0.230
FSC HOURS / TOT A799s	0.2887 (79) S=0.004		0.2384 (79) S=0.016	0.1687 (79) S=0.066	0.4902 (79) S=0.001		0.2046 (79) S=0.033	-0.2018 (79) S=0.035	-0.0516 (79) S=0.324
FSC HOURS / HRS IN RRS	0.4788 (79) S=0.001	0.2384 (79) S=0.016		0.2305 (79) S=0.019	0.1583 (79) S=0.079		0.0658 (79) S=0.280	-0.2082 (79) S=0.031	-0.2245 (79) S=0.022
FLT HOURS / CANN ACTS	0.2706 (79) S=0.007	0.1687 (79) S=0.066	0.2305 (79) S=0.019		0.1710 (79) S=0.064		0.1046 (79) S=0.176	-0.0862 (79) S=0.222	-0.3817 (79) S=0.001
FLT HOURS / TOT A799s	0.4310 (79) S=0.001	0.4902 (79) S=0.001	0.1583 (79) S=0.079	0.1710 (79) S=0.064			0.6376 (79) S=0.001	-0.3439 (79) S=0.001	0.1893 (79) S=0.045
FSC HOURS / FLT HOURS									
FLT HOURS / HRS IN RRS	0.3661 (79) S=0.001	0.2046 (79) S=0.033	0.0658 (. 79) S=0.280	0.1046 (79) S=0.176	0.6376 (79) S=0.001			0.2363 (79) S=0.017	0.4561 (79) S=0.001
TOT A799s	-0.2358 (79) S=0.017	-0.2018 (79) S=0.035	-0.2082 (79) S=0.031	-0.0862 (79) S=0.222	-0.3439 (79) S=0.001		0.2363 (79) S=0.017		0.3700 (79) S=0.001
CANN ACTS	0.0832 (79) S=0.230	-0.0516 (79) S=0.324	-0.2245 (79) S=0.022	-0.3817 (79) S=0.001	0.1893 (79) S=0.045		0.4561 (79) S=0.001	0.3700 (79) S=0.001	

(Coefficient/(D.F.)/Significance

Figure 7. First Order Partials Controlling for $\frac{\text{FSC HOURS}}{\text{FLT HOURS}}$

PARTIAL CORRELATION COEFFICIENTS

	OPRDY	FSC HOURS / TOT A799s	FSC HOURS / HRS IN RRS	FLT HOURS / CANN ACTS	FLT HOURS / TOT A799s	FSC HOURS / FLT HOURS	FLT HOURS / HRS IN RRS	TOT A799s	CANN ACTS
OPRDY		0.5238 (79) S=0.001	0.6146 (79) S=0.001	0.2471 (79) S=0.013	0.3045 (79) S=0.003	0.4834 (79) S=0.001		-0.4280 (79) S=0.001	-0.1282 (79) S=0.127
FSC HOURS / TOT A799s	0.5238 (79) S=0.001		0.5415 (79) S=0.001	0.1204 (79) S=0.142	0.3373 (79) S=0.001	0.8884 (79) S=0.001		-0.3498 (79) S=0.001	-0.1496 (79) S=0.091
FSC HOURS / HRS IN RRS	0.6146 (79) S=0.001	0.5415 (79) S=0.001		0.2230 (79) S=0.023	0.1979 (79) S=0.038	0.5069 (79) S=0.001		-0.3251 (79) S=0.002	-0.2881 (79) S=0.005
FLT HOURS / CANN ACTS	0.2471 (79) S=0.013	0.1204 (79) S=0.142	0.2230 (79) S=0.023		0.1424 (79) S=0.102	0.0574 (79) S=0.305		-0.1257 (79) S=0.132	-0.4874 (79) S=0.001
FLT HOURS / TOT A799s	0.3045 (79) S=0.003	0.3373 (79) S=0.001	0.1979 (79) S=0.038	0.1424 (79) S=0.102		0.1354 (79) S=0.114		-0.6672 (79) S=0.001	-0.1574 (79) S=0.080
FSC HOURS / FLT HOURS	0.4834 (79) S=0.001	0.8884 (79) S=0.001	0.5069 (79) S=0.001	0.0574 (79) S=0.305	0.1354 (79) S=0.114			-0.2626 (79) S=0.009	-0.0826 (79) S=0.232
FLT HOURS / HRS IN RRS									
TOT A799s	-0.4280 (79) S=0.001	-0.3498 (79) S=0.001	-0.3251 (79) S=0.002	-0.1257 (79) S=0.132	-0.6672 (79) S=0.001	-0.2626 (79) S=0.009			0.3133 (79) S=0.002
CANN ACTS	-0.1282 (79) S=0.127	-0.1496 (79) S=0.091	-0.2881 (79) S=0.005	-0.4874 (79) S=0.001	-0.1574 (79) S=0.080	-0.0826 (79) S=0.232		0.3133 (79) S=0.002	

(Coefficient/(D.F.)/Significance

Figure 8. First Order Partials Controlling for $\frac{\text{FLT HOURS}}{\text{HRS IN RRS}}$

PARTIAL CORRELATION COEFFICIENTS

	OPRDY	FSC HOURS / TOT A799s	FSC HOURS / HRS IN RRS	FLT HOURS / CANN ACTS	FLT HOURS / TOT A799s	FSC HOURS / FLT HOURS	FLT HOURS / HRS IN RRS	TOT A799s	CANN ACTS
OPRDY		0.3471 (79) S=0.001	0.5077 (79) S=0.001	0.2426 (79) S=0.015	0.2594 (79) S=0.010	0.2620 (79) S=0.009	0.2994 (79) S=0.003		0.1363 (79) S=0.113
FSC HOURS / TOT A799s	0.3471 (79) S=0.001		0.4859 (79) S=0.001	0.0518 (79) S=0.323	-0.0913 (79) S=0.209	0.8779 (79) S=0.001	-0.2157 (79) S=0.027		-0.1334 (79) S=0.118
FSC HOURS / HRS IN RRS	0.5077 (79) S=0.001	0.4859 (79) S=0.001		0.1827 (79) S=0.051	-0.0746 (79) S=0.254	0.4538 (79) S=0.001	-0.0724 (79) S=0.260		-0.2177 (79) S=0.025
FLT HOURS / CANN ACTS	0.2426 (79) S=0.015	0.0518 (79) S=0.323	0.1827 (79) S=0.051		0.1507 (79) S=0.090	-0.0256 (79) S=0.410	0.1291 (79) S=0.125		-0.3683 (79) S=0.001
FLT HOURS / TOT A799s	0.2594 (79) S=0.010	-0.0913 (79) S=0.209	-0.0746 (79) S=0.254	0.1507 (79) S=0.090		-0.3387 (79) S=0.001	0.8144 (79) S=0.001		0.3928 (79) S=0.001
FSC HOURS / FLT HOURS	0.2620 (79) S=0.009	0.8779 (79) S=0.001	0.4538 (79) S=0.001	-0.0256 (79) S=0.410	-0.3387 (79) S=0.001		-0.3794 (79) S=0.001		-0.1656 (79) S=0.070
FLT HOURS / HRS IN RRS	0.2994 (79) S=0.003	-0.2157 (79) S=0.027	-0.0724 (79) S=0.260	0.1291 (79) S=0.125	0.8144 (79) S=0.001	-0.3794 (79) S=0.001			0.4355 (79) S=0.001
TOT A799s									
CANN ACTS	0.1363 (79) S=0.113	-0.1334 (79) S=0.118	-0.2177 (79) S=0.025	-0.3683 (79) S=0.001	0.3928 (79) S=0.001	-0.1656 (79) S=0.070	0.4355 (79) S=0.001		

(Coefficient/(D.F.)/Significance)

Figure 9. First Order Partials Controlling for TOT A799s

PARTIAL CORRELATION COEFFICIENTS

	OPRDY	FSC HOURS / TOT A799s	FSC HOURS / HRS IN RRS	FLT HOURS / CANN ACTS	FLT HOURS / TOT A799s	FSC HOURS / FLT HOURS	FLT HOURS / HRS IN RRS	TOT A799s	CANN ACTS
OPRDY		0.4524 (79) S=0.001	0.5941 (79) S=0.001	0.2596 (79) S=0.010	0.3341 (79) S=0.001	0.3676 (79) S=0.001	0.1786 (79) S=0.055	-0.3651 (79) S=0.001	
FSC HOURS / TOT A799s	0.4524 (79) S=0.001		0.5178 (79) S=0.001	-0.0310 (79) S=0.392	0.0975 (79) S=0.193	0.8873 (79) S=0.001	-0.2275 (79) S=0.021	-0.3509 (79) S=0.001	
FSC HOURS / HRS IN RRS	0.5941 (79) S=0.001	0.5178 (79) S=0.001		0.0839 (79) S=0.228	0.1097 (79) S=0.165	0.4771 (79) S=0.001	-0.0236 (79) S=0.417	-0.2581 (79) S=0.010	
FLT HOURS / CANN ACTS	0.2596 (79) S=0.010	-0.0310 (79) S=0.392	0.0839 (79) S=0.228		0.2810 (79) S=0.006	-0.1183 (79) S=0.147	0.3561 (79) S=0.001	0.0959 (79) S=0.197	
FLT HOURS / TOT A799s	0.3341 (79) S=0.001	0.0975 (79) S=0.193	0.1097 (79) S=0.165	0.2810 (79) S=0.006		-0.1521 (79) S=0.088	0.6345 (79) S=0.001	-0.3828 (79) S=0.001	
FSC HOURS / FLT HOURS	0.3676 (79) S=0.001	0.8873 (79) S=0.001	0.4771 (79) S=0.001	-0.1183 (79) S=0.147	-0.1521 (79) S=0.088		-0.3799 (79) S=0.001	-0.2978 (79) S=0.003	
FLT HOURS / HRS IN RRS	0.1786 (79) S=0.055	-0.2275 (79) S=0.021	-0.0236 (79) S=0.417	0.3561 (79) S=0.001	0.6345 (79) S=0.001	-0.3799 (79) S=0.001		0.1852 (79) S=0.049	
TOT A799s	-0.3651 (79) S=0.001	-0.3509 (79) S=0.001	-0.2581 (79) S=0.010	0.0959 (79) S=0.197	-0.3828 (79) S=0.001	-0.2978 (79) S=0.003	0.1852 (79) S=0.049		
CANN ACTS									

(Coefficient/(D.F.)/Significance)

Figure 10. First Order Partials Controlling for CANN ACTS

BIBLIOGRAPHY

1. Blalock, H. M., Causal Inference in Non-experimental Research, The University of North Carolina Press, Chapel Hill, N.C., 1964.

2. COMFITWING ONE Instruction 5200.1A, Naval Air Station Oceana, Virginia Beach, Virginia, 8 April 1974.

3. Kendall, M. G. and Stuart, A., The Advanced Theory of Statistics, Vol. 2, chap. 27, Griffin, London, 1961.

4. Nie, N. H., Bent, D. G., and Hull, C. H., SPSS Statistical Package for the Social Sciences, McGraw-Hill, 1970.

5. OPNAV INSTRUCTION 4790.2A, The Naval Aviation Maintenance Program (NAMP), 4 vols., Department of the Navy, Office of the Chief of Naval Operations, Washington, D.C., 18 June 1973.

6. Shchigolev, B. M., Mathematical Analysis of Observations, Lliffe Books, Ltd., London, 1965.

7. Walker, H. M. and Lev, J., Statistical Inference, Holt, Rinehart and Winston Inc., New York, 1953.

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